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Food insecurity and mental health outcomes among people with HIV in West Africa

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Objectives: This study was conducted in order to determine whether food insecurity is associated with poor mental health outcomes among people with HIV (PWH) in Togo and Côte d'Ivoire, West Africa.

Design: Cross-sectional study among participants enrolled in the International epidemiological Databases to Evaluate AIDS West Africa cohort.

Methods: The Household Food Insecurity Access Scale was used to measure food insecurity. The PHQ-9, GAD-7, PCL-5, and AUDIT-C instruments were used to assess depressive symptoms, anxiety symptoms, symptoms of posttraumatic stress disorder (PTSD), and harmful alcohol use, respectively. Logistic regression was used to identify factors associated with poor mental health outcomes.

Results: Among 584 participants (68.8% female, median age 52 years), nearly half (48.1%) were food insecure; 7.0% were mildly food insecure, 26.7% were moderately food insecure, and 14.4% were severely food insecure. Severe food insecurity [odds ratio (OR) 2.63 (1.30–5.34)] and being widowed [OR 2.15 (1.07–4.30)] were associated with moderate-to-severe depressive symptoms and formal education was protective [OR 0.30 (0.15–0.61)]; there was a trend towards an association between severe food insecurity and moderate-to-severe anxiety symptoms [OR 2.14 (0.98–4.70)] and formal education was protective [OR 0.35 (0.18–0.71)]; severe food insecurity [OR 6.87 (2.89–16.38)] and being widowed [OR 3.55 (1.46–8.59)] were associated with PTSD; mild food insecurity [OR 2.74 (1.20–6.26)] and male sex [OR 11.58 (5.44–24.68)] were associated with high risk alcohol use.

Conclusions: Food insecurity is associated with poor mental health outcomes among PWH in Togo and Côte d'Ivoire, West Africa. Future studies to understand and address the causal links between food insecurity and mental health among PWH are warranted.

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Introduction

According to the United Nations Food and Agriculture Organization, nearly a third of the global population is moderately or severely food insecure and does not have regular access to adequate food [1]. The major drivers of food insecurity include conflict, climate extremes, economic downturns, socio-structural inequality, and lack of access to nutritious foods and healthy environments [1]. These factors are particularly important in West Africa, where the prevalence of food insecurity continues to increase, and more than 60% of the population suffers from moderate or severe food insecurity [1].

The factors driving the increasing burden of food insecurity can also contribute to poor mental health. Globally, the prevalence of mental health disorders has increased by 48% in the past 30 years, with an estimated lifetime prevalence of any mental disorder of nearly 30% [2,3]. According to the World Health Organization, the determinants of mental health include "not only individual attributes and interactions with others, but also social, cultural, economic, political and environmental factors" [4]. A better understanding of the factors contributing to the increasing burden of mental health disorders is essential in order to both improve individual health outcomes and reverse this alarming trend.

Individuals living with HIV are uniquely impacted by both food insecurity and poor mental health [5–25]. Food insecurity is highly prevalent among people with HIV (PWH) in West Africa and contributes to poor HIV outcomes, including poor adherence to antiretroviral therapy (ART), loss to follow-up, and virologic failure [17,18,26]. Due to a multitude of social, clinical, and biological factors, including HIV-associated stigma, advanced HIV disease, ART adverse effects, and socioeconomic stressors, PWH are also at increased risk of poor mental health [7,8,13,27]. Prior studies suggest that depression is highly prevalent among PWH in West Africa [8], and may be as much as three times more prevalent among PWH compared to the general population [13,28,29]. Furthermore, mental health disorders such as depression, anxiety, and alcohol use disorder are associated with poor HIV outcomes, including increased risk of nonadherence to ART, loss to follow-up, virologic failure, and disease progression [6,7,30]. While food insecurity has been associated with poor mental health among members of the general population in West Africa, studies to specifically evaluate the relationship between food insecurity and mental health outcomes among PWH in the region are limited [31–40].

Understanding the associations between food insecurity and mental health among PWH may have important implications for the development and implementation of effective interventions to improve health outcomes and quality of life. This study was conducted in order to determine whether food insecurity is associated with poor mental health outcomes among PWH in Togo and Côte d'Ivoire, West Africa. The secondary objective was to determine how social determinants of health modify this effect.

Methods

We conducted a cross-sectional study among a subset of participants enrolled in the International epidemiological Databases to Evaluate AIDS (IeDEA) West Africa cohort at the "Espoir Vie Togo (EVT)" Clinic in Lome, Togo and the "Centre Medical de Suivi des Donneurs de Sang (CMSDS)" in Abidjan, Côte d'Ivoire from November 2021 through June 2022. PWH who were $\geq$40 years old and receiving antiretroviral therapy for $\geq$6 months were enrolled as part of a larger study assessing the burden of noncommunicable diseases in individuals aging with HIV across a variety of low-and-middle income settings [41,42]. Participants were recruited during their routine visit using a systematic random sampling approach. Briefly, during a preenrollment visit and for a given day of HIV care visits, clinicians at the HIV clinic proposed participation to eligible patients using the following procedure: the research assistant in charge of enrollment selected every nth eligible patient (depending on the daily number of eligible attendees receiving HIV care), after randomly selecting the first patient through nth statistical elements as the starting point [43,44]. Data were collected using structured questionnaires, validated instruments, and chart review.

Social determinants of health

Formal education, household income, and marital status were captured using a structured questionnaire.

Food insecurity

The Household Food Insecurity Access Scale (HFIAS) was used to measure food insecurity [45]. Food secure was defined as HFIAS category 1 and food insecure was defined as HFIAS categories 2–4, where category 2 is mildly food insecure, category 3 is moderately food insecure, and category 4 is severely food insecure.

HIV outcomes

CD4 cell count and HIV viral load were captured using chart review.

Mental health outcomes

The Patient Health Questionnaire-9 (PHQ-9) instrument was used to assess severity of depressive symptoms, where a PHQ-9 score of 5–9 was categorized as mild depressive symptoms and a PHQ-9 score $\geq$10 was categorized as moderate-to-severe depressive symptoms

[46–48]. The General Anxiety Disorder-7 (GAD-7) instrument was used to assess severity of anxiety symptoms, where a GAD-7 score of 5–9 was categorized as mild anxiety symptoms and a GAD-7 score ≥10 was categorized as moderate-to-severe anxiety symptoms [48,49]. The PTSD Checklist for DSM-5 (PCL-5) instrument was used to assess symptoms of posttraumatic stress disorder (PTSD), where a PCL-5 score ≥33 was categorized as probable PTSD [50,51]. The Alcohol Use Disorders Identification Test (AUDIT-C) instrument was used to assess harmful alcohol use, where a score ≥4 for men and ≥3 for women was categorized as harmful [52–54].

Statistical analysis

Descriptive analysis was performed for all variables. Logistic regressions were used to identify predictors of mental health outcomes and to evaluate the associations between food insecurity and mental health outcomes using the categories that have been previously validated for each of these scales [46–54]. Variables that were significantly associated with mental health outcomes using simple regression were retained in the multivariable regression models. Missing data were excluded from analysis. *P*-values <0.05 were considered significant. Data were analyzed using SPSS Statistics 29.

Ethical statement

All participants were informed about potential benefits and harms related to study participation and provided written informed consent prior to being included. The respective National Ethic committees of Côte d'Ivoire and Togo approved the study protocol (CMSDS, Côte d'Ivoire:195-21; EVT Clinic, Togo: 01/2022/CBRS).

Results

Characteristics of study participants

Demographic characteristics

We enrolled 584 participants, of which 68.8% were female (Table 1). The median age was 52 years [interquartile range (IQR) 48–58; range 41–80]; 37.7% were 40–49 years of age, 54.3% were 50–64 years of age, and 8.0% were 65–80 years of age. Half of the participants were enrolled in Côte d'Ivoire and half were enrolled in Togo.

Social determinants of health

Nearly 17% had not received any formal education, 31.0% had attended primary school, 43.2% had attended secondary school, and 9.3% had attended university. Nearly 20% earned <25 000 FCFA (<42 USD)/month, 29.2% earned 25 000 to <50 000 FCFA (42 to <84 USD)/month, 23.5% earned 50 000 to <120 000 FCFA (84 to <202 USD)/month, and 27.7% earned ≥120 000 FCFA (≥202 USD)/month. More than half (51.2%) were married or cohabitating, 24.8% were single, 17.3% were widowed, and 6.7% were divorced or separated.

Table 1. Characteristics of study participants, *N* = 584.

	N (%)
Female	402 (68.8)
Age, median years (IQR)[range]	52 (48–58) [41–80]
Age, years	
40–49	220 (37.7)
50–64	317 (54.3)
65–80	47 (8.0)
Country	
Côte d'Ivoire	292 (50)
Togo	292 (50)
Formal education	
None	96 (16.5)
Primary	181 (31.0)
Secondary	252 (43.2)
University	54 (9.3)
Income, FCFA/month[a]	
<25 000	103 (19.7)
25 000 to <50 000	153 (29.2)
50 000 to <120 000	123 (23.5)
≥120 000	145 (27.7)
Marital status	
Single	145 (24.8)
Married/cohabitating	299 (51.2)
Widowed	101 (17.3)
Divorced/separated	39 (6.7)
Food insecurity	
Food insecure	281 (48.1)
Mild food insecurity	41 (7.0)
Moderate food insecurity	156 (26.7)
Severe food insecurity	84 (14.4)
HIV outcomes	
Median CD4 cells/mm^3 (IQR)	583 (396–816)
CD4 <200 cells/mm^3	27 (6.6)
Viral suppression (<200 copies/ml) (*n* = 562)	510 (90.7)
Depressive symptoms	
Mild depressive symptoms (PHQ-9 score 5–9)	178 (30.5)
Moderate-to-severe depressive symptoms (PHQ-9 score ≥10)	68 (11.7)
Anxiety symptoms	
Mild anxiety symptoms (GAD-7 score 5–9)	149 (25.5)
Moderate-to-severe anxiety symptoms (GAD-7 score ≥10)	44 (7.5)
Posttraumatic stress disorder (PTSD)	
Probable PTSD (PCL-5 score ≥33)	23 (3.9)
Harmful alcohol use	
Harmful alcohol use (AUDIT-C score ≥4 for men, ≥3 for women)	132 (22.6)

[a]25 000 FCFA = ∼42 USD; 50 000 FCFA = ∼84 USD; 120 000 FCFA = ∼202 USD.

Food insecurity

Nearly half (48.1%) of participants were food insecure; 7.0% were mildly food insecure, 26.7% were moderately food insecure, and 14.4% were severely food insecure.

HIV outcomes

The median CD4$^+$ cell count was 583 cells/mm^3 (IQR 396–816); only 6.6% of participants had a CD4$^+$ cell

count <200 cells/mm^3. HIV viral loads were available for 562 participants, of which 90.7% had a viral load <200 copies/ml.

Mental health outcomes

Moderate-to-severe depressive symptoms were experienced by 68 (11.7%) of participants, 44 (7.5%) of participants experienced moderate-to-severe anxiety symptoms, and 23 (3.9%) experienced PTSD. Harmful alcohol use was experienced by 132 (22.6%) of participants based upon the AUDIT-C score.

Associations between food insecurity and mental health outcomes

Depressive symptoms

Food insecurity [odds ratio (OR) 2.11; 95% confidence interval (CI) 1.24–3.59], particularly severe food insecurity (OR 3.35; 95% CI 1.77–6.31), was associated with moderate-to-severe depressive symptoms using simple logistic regressions (Table 2). Participants with an income <50 000 FCFA (OR 1.89; 95% CI 1.08–3.30) and those who were widowed (OR 2.78; 95% CI 1.51–5.11) also had greater odds of moderate-to-severe depressive symptoms. Any level of formal education was protective (OR 0.27; 95% CI 0.15–0.49). Sex and age were not associated with moderate-to-severe depressive symptoms. In the multivariable regression model, severe food insecurity (OR 2.63; 95% CI 1.30–5.34) and being widowed (OR 2.15; 95% CI 1.07–4.30) were associated with moderate-to-severe depressive symptoms; formal education was protective (OR 0.30; 95% CI 0.15–0.61).

Anxiety symptoms

Severe food insecurity (OR 2.32; 95% CI 1.07–5.02) was associated with moderate-to-severe anxiety symptoms using simple logistic regressions and formal education was protective (OR 0.34; 95% CI 0.17–0.68; Table 3). Sex, age, income, and marital status were not associated with moderate-to-severe anxiety symptoms. In the multivariable regression model, there was a trend towards an association between severe food insecurity and moderate-to-severe anxiety symptoms (OR 2.14; 95% CI 0.98–4.70); formal education was protective (OR 0.35; 95% CI 0.18–0.71).

Posttraumatic stress disorder

Food insecurity (OR 4.08; 95% CI 1.49–11.14), particularly severe food insecurity (OR 7.41; 95% CI 3.15–17.42), was associated with PTSD using simple logistic regressions (Table 4). Those who were widowed (OR 3.97; 95% CI 1.69–9.34) also had greater odds of PTSD. Sex, age, education, and income were not associated with PTSD. In the multivariable regression model, severe food insecurity (OR 6.87; 95% CI 2.89–16.38) and being widowed (OR 3.55; 95% CI 1.46–8.59) were associated with PTSD.

Table 2. Logistic regressions: predictors of moderate-to-severe depressive symptoms (PHQ-9 score ≥10).

	Univariable				Multivariable			
	OR	95% CI		*P*-value	OR	95% CI		*P*-value
Food insecure (ref: not FI)	**2.111**	**1.240**	**3.593**	**0.006**				
Food insecurity								
Mild FI	1.296	0.461	3.642	0.622				
Moderate FI	1.582	0.817	3.065	0.174				
Severe FI	**3.941**	**1.980**	**7.844**	**<0.001**				
Severe FI (ref: all others)	**3.346**	**1.773**	**6.313**	**<0.001**	**2.630**	**1.296**	**5.335**	**0.007**
Female	1.638	0.905	2.962	0.103				
Age (ref: 40–49)								
50–64	0.919	0.533	1.584	0.760				
65+	1.033	0.362	2.949	0.952				
Formal education (ref: none)								
Primary	**0.319**	**0.155**	**0.653**	**0.002**				
Secondary	**0.286**	**0.146**	**0.561**	**<0.001**				
University	**0.079**	**0.017**	**0.356**	**<0.001**				
Any formal education	**0.267**	**0.145**	**0.491**	**<0.001**	**0.304**	**0.152**	**0.607**	**<0.001**
Income (ref: 120 000+)								
<25 000	2.176	0.950	4.984	0.066				
25 000 to <50 000	2.019	0.958	4.252	0.065				
50 000 to <120 000	1.235	0.533	2.862	0.623				
Income <50 000	**1.887**	**1.080**	**3.298**	**0.026**	1.287	0.703	2.354	0.414
Marital status (ref: married)								
Single	1.475	0.770	2.822	0.241				
Widowed	**3.165**	**1.628**	**6.154**	**<0.001**				
Divorced/separated	1.044	0.291	3.752	0.947				
Widow (ref: all other)	**2.775**	**1.507**	**5.108**	**<0.001**	**2.147**	**1.073**	**4.296**	**0.031**

CI, confidence interval; OR, odds ratio.

Table 3. Logistic regressions: Predictors of moderate-to-severe anxiety symptoms (GAD-7 score ≥10).

	Univariable				Multivariable			
	OR	95% CI		*P*-value	OR	95% CI		*P*-value
Food insecure (ref: not FI)	1.148	0.616	2.142	0.664				
Food insecurity								
Mild FI	0.559	0.126	2.485	0.445				
Moderate FI	0.913	0.417	2.000	0.821				
Severe FI	2.159	0.956	4.878	0.064				
Severe FI (ref: all others)	**2.320**	**1.072**	**5.018**	**0.033**	2.141	0.975	4.698	0.058
Female	1.019	0.522	1.989	0.956				
Age (ref: 40–49)								
50–64	0.658	0.346	1.248	0.200				
65+	0.376	0.085	1.674	0.199				
Formal education (ref: none)								
Primary	**0.356**	**0.152**	**0.836**	**0.018**				
Secondary	**0.333**	**0.153**	**0.726**	**0.006**				
University	0.299	0.080	1.113	0.072				
Any formal education	**0.337**	**0.168**	**0.677**	**0.002**	**0.353**	**0.175**	**0.713**	**0.004**
Income (ref: 120 000+)								
<25 000	0.432	0.151	1.236	0.118				
25 000 to <50 000	0.610	0.270	1.379	0.235				
50 000 to <120 000	0.410	0.153	1.095	0.075				
Income <50 000	0.752	0.382	1.480	0.410				
Marital status (ref: married)								
Single	1.380	0.647	2.943	0.404				
Widowed	1.218	0.513	2.890	0.655				
Divorced/separated	1.592	0.505	5.021	0.427				
Widow (ref: all other)	1.056	0.470	2.372	0.896				

CI, confidence interval; OR, odds ratio.

Alcohol use

Based upon the AUDIT-C score, mild food insecurity (OR 2.45; 95% CI 1.24–4.82), male sex (OR 8.39; 95% CI 5.44–12.92), education beyond primary school (OR 1.57; 95% CI 1.06–2.33), income ≥50 000 FCFA (OR 1.83; 95% CI 1.21–2.76), and being married (OR 2.01; 95% CI 1.35–3.00) were associated with high risk alcohol use using simple regressions (Table 5). Age was not

Table 4. Logistic regressions: predictors of PTSD (PCL-5 score 33+).

	Univariable				Multivariable			
	OR	95% CI		*P*-value	OR	95% CI		*P*-value
Food insecure (ref: not FI)	**4.079**	**1.494**	**11.139**	**0.006**				
Food insecurity								
Mild FI	0.000	0.000	-	0.998				
Moderate FI	2.384	0.716	7.938	0.157				
Severe FI	**9.933**	**3.392**	**29.092**	**<0.001**				
Severe FI (ref: all others)	**7.409**	**3.152**	**17.417**	**<0.001**	**6.873**	**2.885**	**16.375**	**<0.001**
Female	2.208	0.740	6.584	0.156				
Age (ref: 40–49)								
50–64	0.465	0.195	1.108	0.084				
65+	0.346	0.044	2.713	0.313				
Formal education (ref: none)								
Primary	2.006	0.546	7.370	0.294				
Secondary	1.148	0.304	4.334	0.838				
University	0.000	0.000	-	0.997				
Income (ref: 120 000+)								
<25 000	2.928	0.715	11.989	0.135				
25 000 to <50 000	1.932	0.474	7.873	0.358				
50 000 to <120 000	2.006	0.470	8.568	0.348				
Marital status (ref: married)								
Single	2.108	0.668	6.654	0.204				
Widowed	**5.366**	**1.898**	**15.169**	**0.002**				
Divorced/separated	1.285	0.151	10.964	0.819				
Widowed (ref: all other)	**3.973**	**1.691**	**9.336**	**0.002**	**3.546**	**1.463**	**8.593**	**0.005**

CI, confidence interval; OR, odds ratio.

Table 5. Logistic regressions: predictors of high risk alcohol use (AUDIT-C score ≥4 for men, ≥3 for women).

	Univariable				Multivariable			
	OR	95% CI		*P*-value	OR	95% CI		*P*-value
Food insecure (ref: not FI)	1.019	0.691	1.502	0.923				
Food insecurity								
Mild FI	**2.448**	**1.243**	**4.819**	**0.010**	**2.736**	**1.196**	**6.262**	**0.017**
Moderate FI	0.789	0.486	1.282	0.339				
Severe FI	0.943	0.524	1.695	0.843				
Male	**8.385**	**5.444**	**12.915**	**<0.001**	**11.584**	**5.438**	**24.675**	**<0.001**
Age, years (ref: 40–49)								
50–64	1.431	0.939	2.180	0.096				
65–80	1.145	0.528	2.487	0.731				
Formal education (ref: none)								
Primary	1.697	0.855	3.367	0.131				
Secondary	**2.173**	**1.135**	**4.163**	**0.019**				
University	**2.688**	**1.176**	**6.143**	**0.019**				
Education beyond primary school	**1.569**	**1.055**	**2.332**	**0.026**	0.805	0.431	1.503	0.496
Income (ref: <25 000)								
25 000 to <50 000	0.889	0.468	1.689	0.720				
50 000 to <120 000	**2.000**	**1.079**	**3.707**	**0.028**				
120 000+	1.474	0.799	2.720	0.215				
Income ≥ 50 000	**1.826**	**1.209**	**2.756**	**0.004**	0.621	0.306	1.263	0.188
Marital status (ref: married)								
Single	**0.525**	**0.319**	**0.864**	**0.011**				
Widowed	**0.510**	**0.286**	**0.909**	**0.022**				
Divorced/separated	**0.370**	**0.140**	**0.978**	**0.045**				
Married (ref: all other)	**2.011**	**1.347**	**3.004**	**<0.001**	0.651	0.326	1.301	0.224

CI, confidence interval; OR, odds ratio.

associated with high risk alcohol use. In the multivariable regression model, only mild food insecurity (OR 2.74; 95% CI 1.20–6.26) and male sex (OR 11.58; 95% CI 5.44–24.68) were associated with high risk alcohol use.

Discussion

In this study conducted among PWH in Togo and Côte d'Ivoire, West Africa, we evaluated the impact of food insecurity on mental health outcomes. We found that food insecurity is common and is associated with depressive symptoms, anxiety symptoms, PTSD, and high risk alcohol use. To our knowledge, this is the first study to evaluate the impact of food insecurity on mental health outcomes among PWH in West Africa.

Individuals who are both food insecure and living with HIV are confronted by a multitude of biological and social factors that may heighten their risk of poor mental health outcomes. Food insecurity can contribute to poor mental health independent of HIV status as a result of nutrient deficiencies, increased levels of stress, feelings of shame, engaging in socially unacceptable coping strategies, disruptions to household ecology, loss of meal patterns and practices that sustain social cohesion, and increased burden of socioeconomic stressors [39,55–57].

In the relationship between food insecurity and mental health, HIV can be a critical exacerbating factor through both direct and indirect pathways (Fig. 1). HIV status can contribute to poor mental health outcomes due to factors such as HIV-associated stigma, clinical sequelae of advanced disease and opportunistic infections (OIs), side effects of ART, and HIV-associated socioeconomic stressors. These same HIV-associated factors can also lead to food insecurity or exacerbate preexisting food insecurity, thus further contributing to poor mental health through the food insecurity pathway. As such, the relationship between food insecurity and mental health may be amplified in the context of HIV.

Among the few studies that have evaluated the association between food insecurity and mental health among PWH in sub-Saharan Africa (SSA), the vast majority have focused on depression [58–66]. To our knowledge, only one previously published study has evaluated the association between food insecurity and anxiety symptoms among PWH in SSA, and there have been no prior studies that evaluated the association between food insecurity and PTSD in this context [64]. We were unable to identify any previously published studies conducted among PWH in SSA that used validated instruments to specifically evaluate the impact of food insecurity on high risk alcohol use [67,68]. As such, this study helps to address a critical gap in the literature and makes an important contribution to our understanding of the complex relationship between food insecurity and mental health among PWH in SSA.

Depressive symptoms

Consistent with the findings from our study, food insecurity has been associated with depressive symptoms

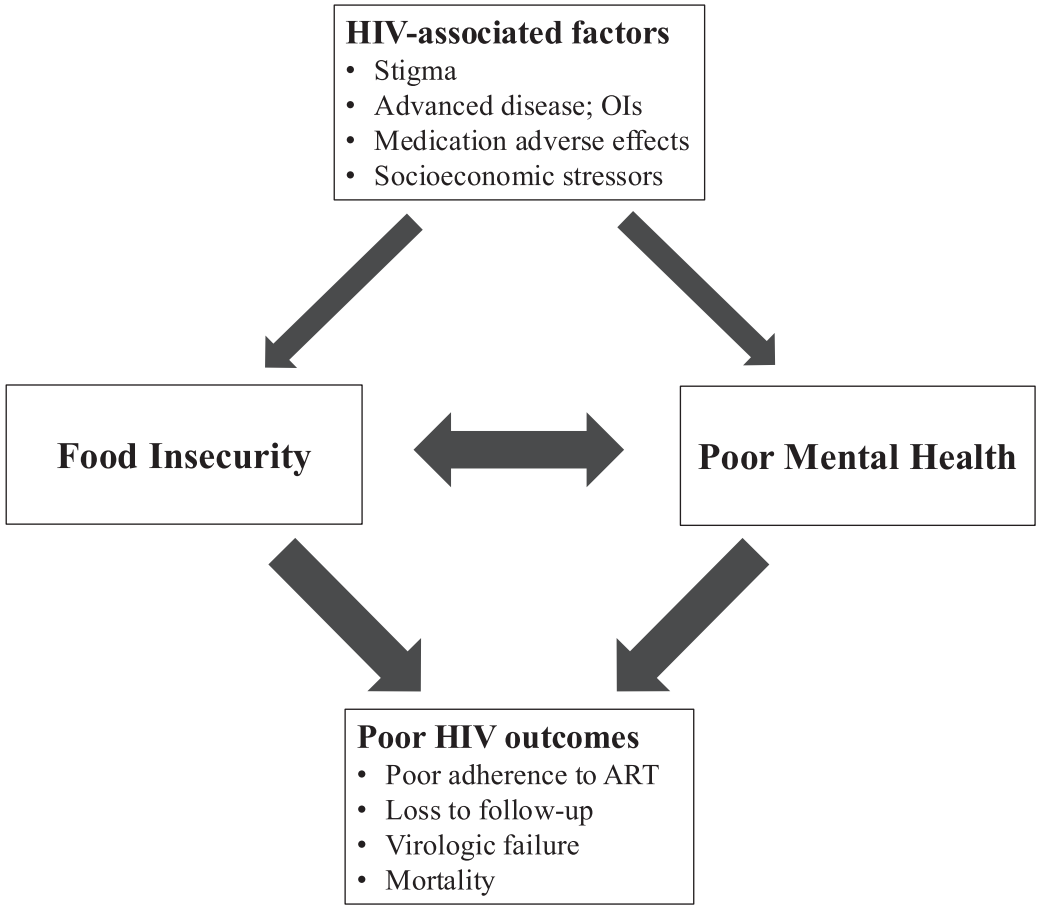

Fig. 1. Relationships between food insecurity, mental health, and HIV status.

among PWH in other regions of SSA, including East Africa (Kenya [58,59], Uganda [61,62], Ethiopia [63], and Tanzania [64]) and Southern Africa (Zambia [65] and South Africa [66]). The majority of these studies used the HFIAS [58,62,65] or an adaptation of the HFIAS to assess food insecurity [59,63,64]. There was greater variation in the instruments that were used to assess depression, which included the Hopkins Symptom Checklist for Depression (HSCL-D) [58,62], the Center for Epidemiologic Studies Depression (CES-D) scale [59,63,66], the M.I.N.I. neuropsychiatric interview (MINI Plus) [61], the Children's Depression Inventory (CDI-S) [65], and the Edinburgh Postnatal Depression Scale (EPDS) [64]. In these studies food insecurity was associated with both greater odds of depression and greater severity of depressive symptoms.

Sociodemographic characteristics that were assessed included sex, age, marital status, education, occupation, household size, number of dependents, urban/rural residence, distance from residence to clinic, wealth, asset index, practice of agriculture, livestock ownership, ethnicity, religion, and social support. In a number of studies, women were more likely to experience depressive symptoms compared to men [58,61–63], though this was not universal. Factors that were protective included marriage [64], livestock ownership [63], and financial capital [66].

Anxiety symptoms

In our study, there was a trend towards an association between food insecurity and anxiety symptoms. We were able to identify a single study conducted in SSA that evaluated the association between food insecurity and anxiety symptoms [64]. This study, which was conducted in Tanzania, used an adapted version of the HFIAS to assess food insecurity. Anxiety was assessed using the six-item subscale of the Brief Symptom Index (BSI-18), which differed from the instrument used in our study. Food insecurity was associated with greater odds of anxiety using simple regression, but not in the multivariable model where marriage was consistently protective.

Alcohol use

We found that food insecurity was associated with high risk alcohol use and men were more likely to engage in high risk alcohol use compared to women. To our knowledge, this is the first study conducted among PWH in SSA that used validated instruments to evaluate the association between food insecurity and high risk alcohol

use. In a behavioral intervention study conducted among women living with HIV in South Africa who use alcohol, food insecurity was associated with less frequent alcohol use [67]. Importantly, neither food insecurity nor alcohol misuse were assessed using validated scales. It is of note that in our study, mild food insecurity but not moderate or severe food insecurity, was associated with high risk alcohol use. As food insecurity can be a correlate of poor economic status, it is possible that income is a factor which limits alcohol use among those experiencing severe food insecurity in some settings.

Social determinants

According to the WHO, the social determinants of health are "the nonmedical factors that influence health outcomes" [69]. Among the social determinants evaluated in our study, the most important predictor of mental health outcomes was formal education. We found that formal education is protective against poor mental health outcomes, as individuals who had received a formal education were less likely to experience symptoms of depression or anxiety. An understanding of the social determinants that contribute to poor mental health outcomes, as well as those that are protective, is essential in order to develop and implement interventions that are informed by socio-cultural context.

Education is considered one of the most important modifiable social determinants of health [70]. It is strongly associated with life expectancy, health-seeking behaviors, and morbidity and is one of the most powerful tools by which individuals can emerge from poverty [70,71]. However, in SSA it is estimated that 105 million children of primary and secondary school age are not enrolled in school and only 23 percent of those enrolled complete secondary education [72]. Among the multitude of innovative and resource intensive health-associated interventions implemented in SSA, ensuring access to formal education should be universally prioritized.

Limitations

This study was conducted among older PWH on ART in urban centers in West Africa. As such, our findings may not be representative of all PWH or populations outside of this context. Our sample was limited to individuals $\geq$40 years of age. Greater age variability of our sample may have improved our ability to detect an association between increasing age and mental health outcomes. Participants in this study were PWH who were enrolled in care and receiving ART, which may have introduced selection bias. As both food insecurity and poor mental health are barriers to retention in care and adherence to ART, it is possible that our sample was biased towards those with greater food security and more favorable mental health outcomes. As such, the prevalence of food insecurity and mental health disorders in our study may be underestimated. While we were able to evaluate the associations between food insecurity and mental health outcomes, an understanding of the causal pathways was limited by the cross-sectional design. A future longitudinal study would help to elucidate the causal pathways between food insecurity and poor mental health and understand how the relationships between food insecurity and mental health change over time. The inclusion of additional social determinants of health would further strengthen future studies.

Conclusion

We found that food insecurity is associated with poor mental health outcomes among PWH in Togo and Côte d'Ivoire, West Africa. These findings suggest that interventions to address food insecurity may help to improve mental health outcomes for PWH. Future studies to understand and address the causal links between food insecurity and mental health are warranted.

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Conflicts of interest

The authors have no competing interests to declare.

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